

XV. *On the Identification of the yet undetermined Species of Microlepidoptera, mentioned in the "Mémoires" of Réaumur.* By J. W. DOUGLAS, ESQ.

[Read 4th October, 1852.]

THE Memoirs of Réaumur and De Geer contain a fund of useful information respecting the food, times of appearance, and habits of insects, but as in neither work the species bear scientific names, an unassisted reader is rather doubtful what particular species are alluded to. The determination of such species of *Tineidæ* as our present knowledge enables us to make will therefore be interesting to the Micro-Lepidopterist of the present day, though many species will still remain unrecognized.

The progress that has been made in the investigation of these small tribes, since the publication in the "Isis," 1838, of Zeller's elaborate review of the *Lepidoptera* mentioned by Réaumur, enables us to correct many errors into which he fell from the then deficient state of knowledge.

In order to make fully intelligible the following notes on Réaumur's observations on Lepidopterous larvæ mining in leaves of plants, it was necessary to translate the whole of those which occur in his first memoir of the third volume. The accuracy of these notices, and the fact that they are nearly unknown to English collectors, would be additional reasons, if any were required, for occupying therewith so much valuable space.

Special reasons are given, in some instances, for coming to a conclusion different from that at which Zeller arrived, in 1838.

Zeller's Memoir was the result of an offer by the "Isis von Oken" of a prize for the best discriminative essay on the subject of the Lepidopterous insects in Réaumur's works; of those submitted in competition, it obtained the first place; and it is very desirable to follow up, from time to time, as our knowledge increases, a work so well begun.

The idea of so doing is due to Mr. Stainton, who also has furnished rough notes of the following matter, which his present avocations have not left time for him to put into form, a work I have endeavoured to do, at his request, adding here and there a few remarks.

RÉAUMUR, Vol. 3, Mem. I.

ON THE LARVÆ WHICH MINE IN THE LEAVES OF PLANTS.

"Of all kinds of caterpillars which live in the interior of some

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parts of plants, the smallest are those which find sufficient accommodation in the interior of leaves, and even in the thinnest. These insects insinuate themselves and form paths between the upper and under skins of the leaves, where they are well sheltered; they mine in the fleshy substance of the leaf and loosen the parenchyma; no rubbish from the space that they enlarge inconveniences them; they eat all that they loosen, and so their labour answers two purposes; for at the same time that they are enlarging their habitation they are procuring their food.

“The insects which mine in leaves, though small, are easily found. One needs only to see the outside of a leaf, to know whether there is a mining larva within; though green and healthy every where else, it is dried up, yellowish, whitish, or at least of a different hue from the rest, at the places which the insect occupies, or has inhabited. The form of these mined places shows us that these insects have three different ways of conducting their labours in the interior of leaves. Some form only narrow, long, and tortuous galleries, the forms of which are extremely irregular; others, wishing to have more room, mine irregular, oblong, larger places; and others, which when young have mined in galleries, when full grown mine in large patches.”

Note.—Those larvæ living in galleries are all, as far as we are at present informed, of the genus *Nepticula*; possibly *Trifurcula* also mines in galleries, but that is not yet ascertained, no species of the latter genus having been bred. The gallery of a *Nepticula* may, I believe, be always distinguished from that of a Dipterous larva by the excrement forming an uninterrupted line; in the galleries mined by Dipterous larvæ, the excrement is scattered here and there, as may be easily seen in the leaves of buttercup, holly, honeysuckle, meadowsweet, &c. &c.

“Although the class of insects which mine in leaves has as yet (1737) been little observed, it already includes a great number of species. There are few trees or plants, if there are any, that are not attacked by some mining larva. There are even miners of different species in the leaves of the same plant or tree; and we see not only the different leaves of an apple tree, but even one leaf of the same tree, mined both in galleries and blotches. Probably the same tree furnishes food to gallery-miners and blotch-miners of several species.”

Note.—I have in one apple leaf observed several larvæ of each of the three species, *Lithocolletis Pomifoliella*, *Ceniosstoma scitella* and *Nepticula*?

“It is sometimes difficult to perceive in what these species of such small insects differ from each other; besides, it is not cer-

tain that the insects that mine in the leaves of different plants are always those of different species. Yet, as miners of different species and different genera feed in the same leaf, it is very probable that there are as many or more species of insects mining in leaves, as there are species of trees and plants."

Note.—It is true that this is not certain, but excepting in the case of closely allied plants, the probability is that each species of plant nourishes a different species of moth.

"The greater part of these mining larvæ live entirely alone; each gallery and blotched place being the habitation of only a single larva, which has no communication with those of other insects of the same or different species, though made in the same leaf. There are, however, leaf miners, which having passed a large portion of their life in solitude, meet when the period of their metamorphosis approaches. After living till then in narrow galleries, they wish for more spacious dwellings, and mine together in blotches. It is not difficult to find oak leaves, before the end of spring, in which are several narrow and tortuous galleries, which all converge and terminate in a whitish blotch, which is sometimes half as large as the leaf (*Coriscium substriga*). The upper epidermis of this leaf has been loosened by several little caterpillars, for which it forms a closed tent, under which they eat the fleshy substance of the leaf without fear of interruption; at first they had each lived separately in narrow paths.

"There are also miners which from their birth are in companies of twenty or thirty in the same blotch, which they enlarge daily as they feed. Such societies are found in the leaves of lilac (*Gracillaria Syringella*); the caterpillars are white and smooth; they have six true legs, but no prolegs; their anal segment helps them to walk, and serves as a seventh leg."

Note.—It is only when young that the larvæ of *Gracillaria Syringella* have no prolegs; when fully grown, they have fourteen legs, as other larvæ of the genus.

"Among the mining caterpillars, it is easy to recognise the characters of two different classes; there are some with sixteen legs; others have only fourteen legs, having only six ventral prolegs; the first pair of prolegs is only separated from the last pair of true legs by two segments without legs. Probably there are several other classes.

"Among the mining larvæ, some, except in size, are very similar to ordinary smooth caterpillars; but others have the segments more marked, more indented than those of ordinary caterpillars; the bodies of some, and especially the posterior portion, seem composed of beads, threaded like those of necklaces. The

anterior segments are more flattened; the second or third is the broadest of all; hence it follows that the anterior portion of the body forms a kind of isosceles triangle. The second segment of some seems widened by two appendages, portions of spheres that have been added on each side; this may be observed in the larva which mines the leaves of the rose in blotches. But what appears most remarkable is, that one seems to perceive on each of those parts that extends beyond the others a fissure which can only be a stigma or organ of respiration; thus these stigmata are placed much nearer the middle of the back than in ordinary caterpillars."

Note.—The breadth of the second and third segment is very striking in most of the larvæ of the genus *Lithocolletis*.

Note.—The larva which mines the leaves of the rose in blotches is unknown to me. *Coleophora Lusciniaepennella*, it is true, makes blotches on the leaves, but so accurate an observer as Réaumur would never have mistaken a *Coleophora* for a miner; and it is remarkable that he repeatedly mentions this rose miner, and in one place states that there are no shrubs on which blotch miners are more common than the roses; this larva was an *incognita* to Zeller, in 1838, and still remains lost to us. Whether the species be really extinct, or only wants looking for, time must prove. But although we do not know this species, I think we know what is intended by the widening of the anterior segments by an appendage like a portion of a sphere, for in a larva mining the leaves of black thorn, the black head deeply set into and working up under the wide and pale next segment, imparts thereto its own colour, and makes the rounded sides of this segment, which project beyond the sides of the inserted head, look like semi-spherical appendages.

"All these mining larvæ have a tender, transparent, and smooth skin, but all are not of the same colour; the greater part, however, are whitish, or greenish white; some are of a pale flesh colour, and others of a deeper flesh colour, approaching to red.

"There are also a great many species which are of a beautiful yellow, resembling the colour of amber: this is the colour of the blotch miners of the apple tree (no doubt *Lithocolletis Pomifoliella*, the colour well agrees) and also of the gallery-miners in the leaves of the bramble (*Nepticula aurclla*). A blotch miner of rose-leaves, already mentioned, is of a greyish olive. Commonly, these colours are not clouded, varied and combined by spots and rays as are those of many caterpillars which feed on leaves. However, we find in the leaves of the goose-foot and orach a larva mining in blotches, which, if as large as common caterpillars, might be

put among the well-coloured ones. The ground colour is a yellowish white, but all along the back is a reddish-brown stripe, and on each side are two rows of spots, redder than the dorsal stripe, and well defined, one spot being placed directly above the other on each segment."

Note.—*Gelechia næviferella* is here alluded to, and not *G. Hermannella*, as Zeller, in 1838, had imagined. *Hermannella* makes a green blotch, afterwards becoming yellowish, but *næviferella* an extremely white and transparent one; the description of the larva agrees well with that of *næviferella*, but not, as Zeller had remarked, with that of *G. Hermannella*.

"The place at which a gallery miner (just emerged from the egg) has entered a leaf is easy to recognize; it is so narrow as to be hardly as wide as the finest thread; but the path gradually widens, and at the other end is nearly as wide as a narrow riband; for by degrees, as the miner excavates and opens out a road before him, he eats and grows, the diameter of his body increases, and requires a wider habitation. If we take a leaf mined in this way, and hold it up to a light, or better still, to the sun, such places being transparent, we shall not fail to see the insect, if indeed it has not already quitted the leaf; and its head will be always at the broadest end of the gallery. In the entire space which it has previously inhabited (*Nepticula*), we observe little black grains, which are nothing but the excrement it has made on its road. These grains are placed in a row behind one another, but in the wider galleries there are several rows placed side by side. In the leaves mined in blotches, the excrements are all collected in a little heap; some species place them in the centre of the mined place, and others in a corner.

"If, when we examine the mining larva, it happens to be at work, we shall see it seize between its teeth, as between pincers, and detach the parenchyma of the leaf; or at least we shall perceive that a part of the leaf previously opaque has become transparent, because the fleshy portion has passed into the body of the insect. The two jaws, which form a point in front of the head, are well fitted to open a road in the substance of the leaf and to seize minute portions. One can very easily observe the blotch miner of the rose, while excavating in the thickness of the leaf(?) We observe still more easily that of the goosefoot, or orach, because in the places which it mines it only leaves a white and very fine skin (*G. næviferella*).

"The labours of the blotch miners, roughly considered, seem to have in them nothing more singular than those of the gallery miners, except that whereas the latter always mine before them,

and advance as they mine, the former mine all round the place they inhabit ; this place is marked on the leaf by a white or yellowish blotch, being in fact the portion of the leaf that has been detached. Had this portion been simply loosened, it should be every where even and smooth, as when it was attached ; consequently, it appeared to me very singular, when for the first time I observed on a portion of the membrane of an oak leaf a ridge (*arrête*) projecting above, which went from one end of the mined place to the end diametrically opposite. It was at first natural to suppose that this ridge was nothing but a large fibre loosened from the leaf ; but its direction and figure destroyed this idea, and showed that it was not a fibre of the plant. I have since constantly observed this ridge on all portions of the epidermis which had been separated from the parenchyma of the oak leaves by certain species of miners, and I was puzzled how it could be produced, till I observed the mined blotches in apple and elm leaves. These mined places showed me why the loosened epidermis of certain oak leaves has a ridge, what is the use of this ridge, and how it may be formed. The elm leaf miners (*Lithocolletis Schreberella*) are of the largest insects of this kind, yet the space included between two parallel fibres which start from the mid rib bound the space in which each excavates and feeds ; these fibres are for it two chains of mountains, which stop it on each side ; hence it makes its abode longer than broad, somewhat oblong. It is the lower epidermis of the leaf which it first loosens, and it afterwards eats all the pulp that is between this and the upper epidermis. Instead of one ridge, such as I had seen on the oak leaves, I have often seen two or three, and sometimes more, on the loosened epidermis of an elm leaf. The structure of each of these was easier to recognize than that of those of the oak ; it was evident that each was only a fold of the epidermis, and that the summit of the fold which rose above the rest formed the ridge in question ; this was shown in tracing each ridge from one end to the other, because towards one end were seen the two portions of the epidermis which began to curve towards each other, and a little further they were almost contiguous, whence it was easy to judge that in the rest of their extent they were applied *exactly one against the other*.

“ The effect produced by these folds of the membrane is evident, they contract it, and consequently force the fibres to which it is attached to approach each other ; the opposite membrane on which the substance of the leaf rests is also thereby compelled to curve and become convex on the outside of the leaf. The advantage to the insect is apparent ; it obtains a tenement of greater

height, it forms a cavity proportioned to its size, and the movements it has to make; the membrane no longer rests on its body, as it otherwise continually would, and it has no longer so many rubbings to fear.

“ Nothing is more confirmatory of the idea that this is the true use of the folds in the epidermis of the leaf, than the form that our blotch miners cause the apple leaves in which they reside to assume. Above the places where they reside we observe folds similar to those of the elm, but often there are more; on the loosened side of the epidermis, which is here generally the upper (*Lithocolletis Corylifoliella*?) two parts of the leaf, which in their natural position were seven or eight lines asunder, are sometimes brought so close together as almost to touch: there the folds of the epidermis have been so multiplied, so squeezed together, that it only retains a small portion of its first extent of surface, but the insect has thereby obtained a deeper cavity in which to live. The time when the miners of this species are most numerous, and when their labours on the apple leaves are most advanced, is when the latter are ready to fall, that is, towards the middle or end of October; if we then observe those leaves which more than others are folded along the principal nervure, or which appear folded in some other places, that part where the fold is most considerable is the abode of the insect. We often find two or three similar abodes on the same leaf. Some insects take up their quarters on the under side (*Lithocolletis Pomifoliella*), but these are few in number. At the same period we also find most in the elm leaves.”

Note.—Réaumur apparently supposed that the larva mining the upper side of the apple leaf was the same as that mining the under side; the whole of our recent experience however shows us that the same species keeps constantly to the same side of the leaf, and consequently an upper side miner cannot be specifically identical with an under side miner. I am not aware that the larva from the upper side of the apple leaf has yet been bred; it is probably identical with the larva of the upper side of the hawthorn leaf (*Lithocolletis Corylifoliella*, Haw.). Here it is not nearly so common as the larva of the under side of the leaf (*L. Pomifoliella*).

“ The three kinds of miners of which we have spoken—those of the oak, those of the elm, and those of the apple—are larvæ with fourteen legs, and which have only six ventral prolegs, so placed that between these and the anal prolegs are three segments without legs. The miners of the apple leaf are of a yellow, approaching to amber; the miners of the oak leaf are white, slightly

tinted with greenish; the colour of the contents of their stomach and intestines may probably give this tint to their transparent skin. It would not be safe to decide that these three larvæ belong to the same or different species, if the insects into which they changed did not show it, and if we could not say that the mode of preparing for their metamorphosis is different. If in the month of October we remove the epidermis that has been folded by one of the apple leaf miners, we find a chrysalis which has not been enclosed in a cocoon. If at the same time we open the mined part of an oak leaf we also find a chrysalis, but enclosed in a small cocoon of fine white silk, to fortify which the larva has covered the exterior with its excrement."

Note.—It is not possible to identify with precision Réaumur's oak miner; the pupa of several species of *Lithocolletis* that feed on the oak is enclosed in a cocoon covered with excrement as he mentions: his figure of the imago would appear to indicate *L. Cramerella*.

"Finally, if we open the mined part of the elm leaf we find a very small but pretty silky cocoon, which has on a small scale the form of the cocoon of the silkworm; it is however rather more elongated and more pointed. The colour of the silk of these cocoons is not of the ordinary colour, it is of a bluish-green."

Note.—Zeller had here suspected *Lithocolletis Kleemannella*, but the proofs are so strong for *Schreberella* that I have no hesitation in pronouncing that to be the species, the greenish-blue cocoon giving a climax to this supposition.

"Among the miners of which we speak some go into pupa in June or July, and it was only to point out the time when most are to be found, that we said they should be looked for towards the end of October; when the leaves fall, the chrysalides which are in the leaves fall with them. Those which are enclosed in cocoons are at least in some degree sheltered, when the leaf decays; I know not whether the others are able to resist moisture, or whether many do not perish during the winter.

"I have omitted to seek for the moth of a miner of the leaves of the pear, which is not so frequent as the miner of the apple leaves. It folds, like the latter, the epidermis which it has loosened; it has also fourteen legs, but it is greenish white, whereas the miner of the apple tree is yellow."

Note.—It is probable that a pear tree miner would not differ from the miner of an apple tree; probably in this case Réaumur alludes to the upper side miner, his yellow larvæ being the under side miner.

"But at the beginning of spring I had the moth from a cater-

pillar which mines in blotches the leaves of the nut, and which makes a ridge on the epidermis of the mined part. This moth may vie with all others in beauty, its anterior wings are streaked transversely with clouded gold and shining silver; on each wing are six or seven gold stripes, and four or five silvery."

Note.—As the larva of *Lithocolletis Coryli*, Nicelli, mines the upper side of the nut leaf in blotches, and the larvæ of *L. Nicellii*, the underside, and Réaumur does not mention on which side his larva fed, it would have been impossible to identify the species but for his description of the perfect insect, which, though none of the best, sufficiently points to *Nicellii* in preference to *Coryli* to indicate that as the species. In other cases I have omitted to refer to his descriptions of the perfect insects, as in few instances are the species recognizable. The descriptions were probably made, as Zeller has suggested, from specimens which had been allowed to die in boxes, and afterwards injured in pinning.

"Since these mining larvæ are able to spin, as they make cocoons, we need no longer wonder how they can form those kinds of ridges, those folds of the epidermis, which they have loosened, and under which they lodge. We have elsewhere (Vol. II. Mem. V.) seen the proceedings of the larvæ which roll and fold leaves by means of thread, which they place in different directions, and then load with the weight of their body; let us suppose a similar industry in these miners, and this is all that is necessary on their part to cause the loosened membrane to assume these folds. It is true that in these folds, among those which only form a simple ridge on the leaves of the oak, the parts approximate far more closely than when leaves themselves are folded, but then our mining insects have to deal with a membrane incomparably finer and thinner than a leaf. They spin webs on the interior portion of their cavity, and it is these webs which force the membrane to bend. Their webs are so fine and close that I should not have recognized them had I not known that our insects must have made them."

"All the miners which mine in blotches do not, however, form folds in the membrane which covers them. M. Vallisnieri has mentioned a larva which mines galleries in the rose leaves of our gardens."

Note.—The gallery miner of the rose leaves in our gardens is a *Nepticula*, but unfortunately for deciding on the specific name, it happens that two species feed in the rose leaves. However, that which seems the most common is *Nepticula anomalella*; these larvæ, when full grown, emerge from their galleries, and generally form their yellowish-brown cocoons at the base of the footstalk of the

leaf, a fact first observed, or at least made known at one of our meetings, by Mr. Westwood. Where the cocoons of other species are placed is not yet known.

“ We also find on the same roses and on the dog rose blotch miners; indeed, there are no shrubs on which these miners are more common. The membrane of the upper side only makes a little protuberance outwards. We also find on the holly, nut, oak, &c. great places mined and covered by the epidermis, which forms a convexity outside the leaf, without having a sensible ridge.

“ This epidermis, in drying, might easily become more stretched, but the shortening of its fibres cannot force it to assume a convex form; it is by spinning one or several very fine webs that the miner has obliged it to separate, and to keep apart from the portion of the leaf from which it has been loosened. These webs are, however, as already mentioned, hardly perceptible but by the effects they produce; but in order to convince myself that the insects do spin them in places where they may be necessary, I pierced with the point of a penknife the thin membrane that was above the mined place of a rose leaf, and made a small rent which allowed me to see the insect exposed. When I wished to examine the same gap twenty-four hours afterwards, I found the edges reunited by a web which the miner had spun on the interior surface of the torn epidermis. I cut in the same way the membranes which covered the blotch miners of the apple, and they behaved in the same manner as the rose miner.

“ We may, however, assure ourselves without this experiment that the miners of the apple carpet with web the epidermis they have loosened; if we open their small abode it is best to do so on the thick side, and we see all the edges of the fleshy part, which is joined to the epidermis, are whitish, though at a short distance from these the fleshy part is quite green. The web which is spread over the epidermis goes a little beyond the place where it is joined thereto.

“ We only perceive the green of this fleshy part through a white veil spread over it.

“ Besides the insects which form a ridge on the portion of the epidermis of the oak leaves which they have loosened, there are caterpillars, as we have just seen, and even of different kinds, which mine the same leaf, and which only cause the epidermis of the mined part to assume a slight convexity. If we observe at certain times the portion of the epidermis which has been raised by some larvæ, it seems to have in its middle a circle more opaque than the rest; this I have observed, more than at any other time, towards the end of July. If we raise this portion of

the epidermis we shall see that this white circle does not belong to it; that opposite the place where it appeared is a little cocoon of white silk; it is nearly circular, and fastened to the leaf itself. Towards the 15th August small moths made their escape from these little cocoons (*Tischeria complanella*)."

Note.—I have not yet bred this species, and no modern writer has given a detailed account of the mode of living of the larvæ and pupa; Ratzeburg, it is true, described and figured the larva, but he states that the *larvæ winter* in the leaves, and makes no mention of the singular circular cocoon. Mr. Stainton once found such a cocoon in a leaf of *Centaurea nigra* at Mickleham, in August, but the tenant died, and he much doubts whether it was Lepidopterous.

"Early in spring we may observe thousands of oak leaves, of which very large portions of the upper epidermis have been loosened; that of more than half or three quarters of the leaf is raised, and forms very frequently a slight convexity; but these large mined places are also the work of several miners, which, after living in solitude during a portion of their life, have united to labour at the same work. If we look at the part of the leaf which is between the large mined place and the foot stalk, we shall see several narrow and tortuously mined galleries, which are the roads in which the insects have lived and grown, and which they have followed to arrive at a point where they should mine together on a large scale. If we, towards the beginning of June, remove the epidermis of the large mined place, the part of the leaf which we expose to view is very green, and sometimes very smooth; it does not appear that its substance has been eaten, neither do we see any excrements therein, but we immediately observe two, three, or four places, according to the size of the mined portion, which are raised and white. They resemble small portions of, as it were, a second epidermis, which had been loosened, or places which had been mined a second time. These places are those where each little caterpillar has spun a cocoon so thin, and of so close a texture, that it appears only to be an epidermis of the leaf; it has, at any rate, the colour of it; but we can convince ourselves that this covering has been spun; for if we tear it we can distinguish the threads of which it is composed, and see that the texture does not at all resemble the epidermis of a leaf."

Note.—There seems little doubt that *Coriscium substriga* is the insect here alluded to, but, according to Mr. Sircom's observations, the larvæ quit the leaves previous to spinning their white cocoons; whereas Réaumur describes them as spinning their

cocoons beneath the epidermis of the leaf: as that is contrary to the rule in other species of the *Gracillaria* group, I am inclined to fancy some mistake.

“The cleanliness of a miner which makes blotches on the leaves of the oak does not admit of our confounding it with many others. There is, however, nothing particular in its labour; the space which it mines is nearly circular; the epidermis which covers it has a slight convexity, without having a ridge. When not mining, it is very generally bent as a bow. If we remove the epidermis that covers it, we perceive no excrement in its abode; it has the precaution to make it outside its dwelling. In observing one of these larvæ, I saw it walk backwards, till its anus was close to the edge of its abode; it even made it go beyond, for there was a little slit for it to go through, which the larva knew where to find, and it then ejected a little black grain, and immediately the larva retired into the middle of its dwelling. When I afterwards examined with a lens the places mined by the larvæ of this species, I recognized that they had all a little slit on the upper surface of the leaf. The excrement which they eject at this opening very frequently falls to the ground, being hard grains, which roll on a smooth surface. In vain did I examine this insect with a powerful glass, and in a strong light, I could find no legs even when it tried to walk. Its body is white, but the head and tail are brown; the anus is beneath, and has a wide border; the head is very flat; the jaws, which are the most marked parts of it, form a point where they meet. The exterior form of each is an arc, which seems a portion of a circle.”

Note.—This “clean miner,” as Réaumur called it, is very probably *Tischeria complanella*: at any rate, a larva which corresponds to Réaumur’s account, and also to Ratzeburg’s observations of that species, makes blotches on the oak leaves in September and October.
